Problem identification

How can a typical consumer determine which cellular phone service is best suited for him? For purposes of this project we will assume that the consumer has made the decision to purchase a cellular phone service; thus, the problem is not whether or not the service is needed but how to select the best-suited service. The problem exists because there are several cellular phone service providers with a wide variety of service plans available. If there was only one cellular phone service provider with only one service plan available, there wouldn't be a problem. Thus, for our typical consumer in Central California who has decided to make the purchase, a problem exists.

For someone who is faced with this problem, our Decision Support System (DSS) will be a reactive one. For someone who has not made the decision, it will be proactive. The stakeholders are the typical consumers deciding which service to purchase and the cellular phone companies. The solution will be different for each consumer based on individual preferences and/or needs.

Problem objective

The objective of the DSS is to help residential consumers select the cellular phone service best suited for them based on their preferences and/or needs while maximizing the benefits and minimize costs.

Decision objectives

Maximize value of outcome variables.

Outcome Variables: (performance measurements)

1. Satisfaction
2. Actual total cost over time

** good. Time = planning horizon

Criteria: (surrogate outcome variables used to evaluate alternatives)

1. Cost
2. Quality of service
3. Coverage

Assumptions

1. The consumer has made the decision to purchase a cellular phone service.
2. User will be a typical customer in Central California.
3. It is possible for the consumer to change his mind and decide not to purchase the cellular phone.
4. The user will assign weights to the variables.
5. It is possible for the user to decide not to buy a cellular phone.
6. Costs are non-negotiable.
7. Service plan can only be from one to four years long.
8. User has a limited budget.

Constraints
1. Only one type of phone will be chosen.
2. Number of accessories can vary from 0 to n.
3. Only one service plan can be purchased.
4. Total cost of cellular service plan, phone, and accessories must be less than user's budgeted amount.

User inputs
- User's phone preference
- User's phone requirements (usage, purpose, etc)
- User's budget
- User's desire for accessories and features
- User's weight assigned to cost factor
- User's weight assigned to quality of service factor
- User's weight assigned to coverage factor

** nice and clear.

Controllable Variables: (Those variables that the decision maker can, or seeks to influence in solving the problem.)

1. Product (phone)
2. Calling plan (minutes per month): exogenous, discrete, and deterministic.
3. Service provider (GTE, Cellular One, etc.): discrete, deterministic, endogenous.

Uncontrollable Variables: (Given, outside scope of decision maker.)

1. Footprint (coverage area): exogenous, continuous, deterministic
2. Cost (phone, service plan, accessories, etc): endogenous, continuous, deterministic
3. Usage

Sets
1. Service Provider (GTE, Cellular One, PacBell, etc.): S
2. Calling plan (Basic, Midrate, Heavy use): C
3. Phone (brand and type): P
4. Accessories (cover, extra battery): A

Variable definition

Total Cost (s, c) = onetime cost(s, c, p) + sum monthly cost (s, c, m) + accycost(a, p) + phcost(p)

Monthly cost = monthcost(s ,c, m) = fixed monthly rate (s, c) + (perminrate (s, c) * exssmins(e)) + longdistcost(s, c, n)

Local per minute rate = perminrate (s, c)

Long distance costs = longdistrate(s, c) * longdistmins(n)

Long distance rate = longdistrate(s, c)

Accessory cost = accycost (a, p)

Phone cost = phcost (p)

Number of excess local minutes = exssmins(e)

Number of long distance minutes = longdistmins(n)

Example: The cost of a one year contract with GTE for a basic calling plan using a Nokia 3000GT portable phone with an extra battery will be annotated as follows:

Total cost (GTE, basic, Nokia 3000GT, 12 month, extra battery) = onetimecost(GTE, Nokia 3000GT) + sum monthlycost (GTE, basic, 12) + accycost (extra battery, Nokia 3000GT) + phcost (Nokia 3000GT).

** ok, going very well.

Alternative space

- 5 service providers.

- 9 calling plans for each service provider.

- n number of different phones offered by each service provider.

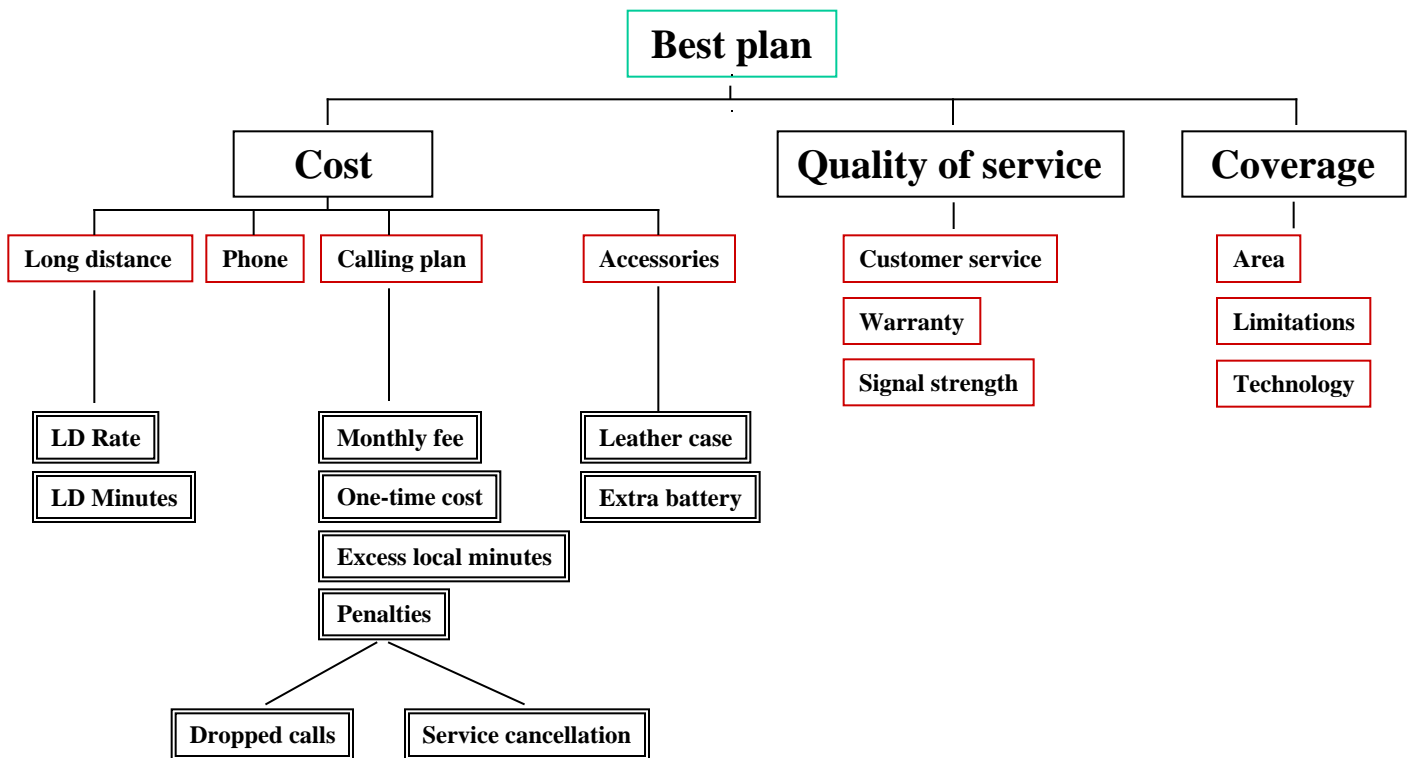*Example*: (n products/phones) * (9 types of calling plans) * (5 service providers) = 45 * n options

Decisions to be made

- Service provider from which to purchase service
- Type of phone to purchase
- Type of service plan to purchase

*** wonderful. You've identified and structured problem components very well. Now we need to reduce the scope of the problem so it becomes more manageable in the time constraints.

Criteria Hierarchy

Best plan

Cost

Quality of service

Coverage

Long distance Phone Calling plan Accessories

Customer service

Area

Warranty

Limitations

Signal strength

Technology

LD Rate

Monthly fee

Leather case

LD Minutes

One-time cost

Extra battery

Excess local minutes

Penalties

Dropped calls Service cancellation

new service plan). The optimizing strategy will be used to maximize customer utility based on customer designated weighting of three criteria: 1) cost, 2) quality of service (QOS), and 3) quality of equipment/instrument (QOE) .

Model Components:

Overall decision objective - Maximize customer utility

    Subobjectives -   1) Minimize total cost

                            2) Maximize customer's needs/preferences

Sets - I: Instruments; P: Plans

Alternative Space - AltSpace = (i, p) a discrete collection of all valid combinations of
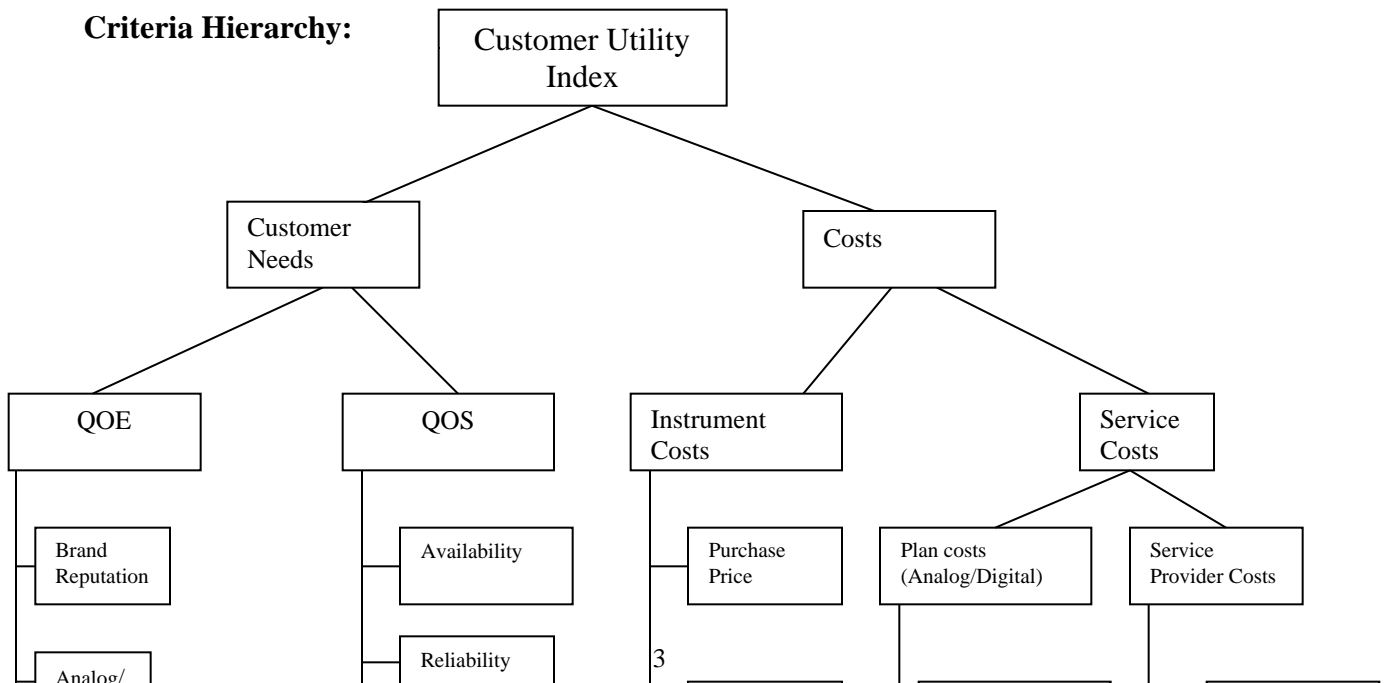   i and p.

                           constraint - P can not include the null value (*however I can*)

Criteria - Total_Customer_Utility = cost_factor + QOS_factor + QOE_factor
           Subject to - Cumulative weights of customer's preferences (factors) = 100%

Modeling Task - Solve: Solution set contains N number of combinations of (i, p) with the highest overall Total_Customer_Utility values.

Criteria Hierarchy:

3

Table of High Level Variables:

	Outcome	Decision	Controllable	Uncontrollable	Endogenous	Exogenous
Utility	X				X	
p{P}		X		X	X	
i{I}		X		X	X	
P{all}				X		X
I{all}				X		X
Own_phone			X			X
A/D Analog/Dig			X			X
Other_Pref (TBD)			X			X

** above: how is P both a decision variable and uncontrollable ? same for I

Dependency Diagram:

Phase 1:

Elimination Strategy

Phase 2:

Optimization Strategy

Phase 3:
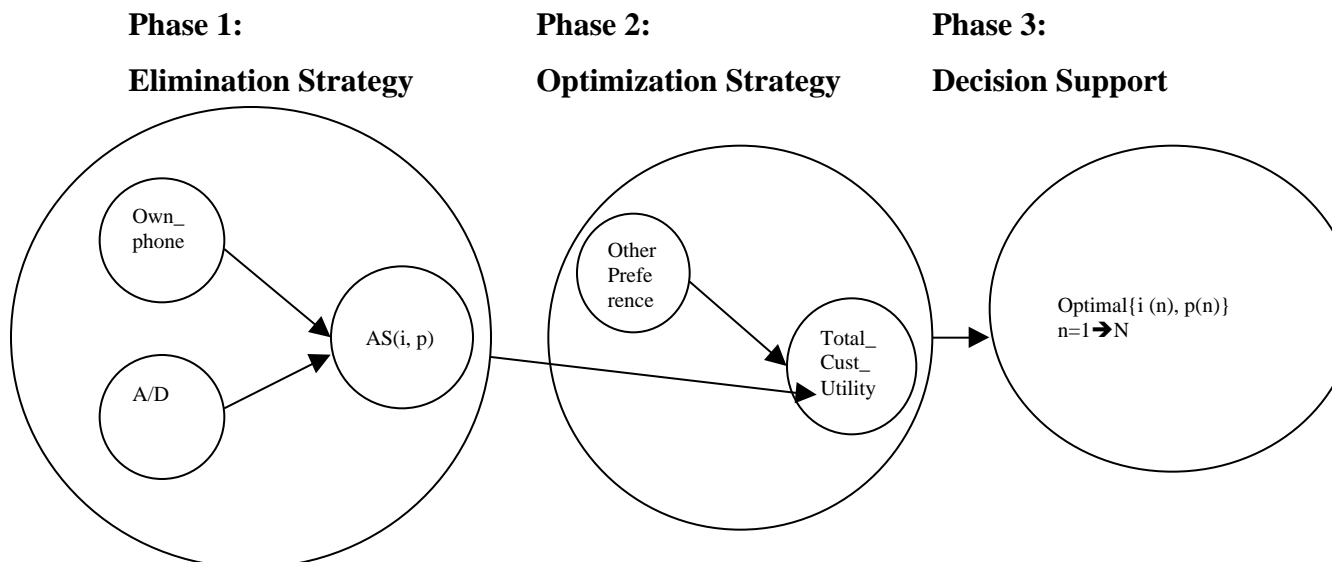
Decision Support

I.   INTRODUCTION

The purpose of this decision support system is to help a typical NPS student select a cellular phone service that includes both the phone instrument and the associated service. It will help the student examine possible alternatives, view relevant information about them, explain and follow a good decision process, rate alternatives on multiple criteria, combine rankings along multiple criteria, advise them about different utilization scenarios, and analyze alternatives under utilization scenarios of interest to the consumer. ** ok

II.   BODY

1.   Defining the problem

The problem is establishing a means of mobile communications that would be used by a typical NPS student. Such a system is desired for easier communication and a sense of security between the student and his family. The primary goal of this DSS is to enable the student to have a tool that helps determine the best phone and service possible available from different companies offering cellular phone service. Each company offers various hardware items and services that will meet consumer needs.

In essence, the DSS will answer three questions:

1.   What is the best Phone Product?
2.   What is the best Service Plan?
3.   Who is the best Service Provider?

** to be precise, what's the BEST COMBINATION of these (you may end up with a phone or plan that is not the best by itself …)

2. Decision Variables

This section provides the reader with a complete list of all variables, their definitions and symbols used in the construction of the model. Refer to Figure 1 for a depiction of the interdependency of the variables.

Are the variables below DECISION variables? They seem mor e like variables that will influence the outcomes and hence help in making the decision … but the decision problem isn't to find values for these variables. See your 3 questions above … your decision variables should be consistent with these questions (and with the alternative space defined (correctly) later).

Total Cost: **(TC)** (Uncontrollable, Discrete, Endogenous, Random) Total Cost of the phone system

- $TC = IC + RC$

Initial Cost: (IC) (Controllable, Discrete, Exogenous, Deterministic)
Range of Values: $0 - 200.

- IC = AF + COP

Activation Fee: (AF) (Controllable** by whom ? , Discrete, Exogenous, Deterministic)
Range of Values: $0 - 20. Each company will charge this fee to start the service.

Cost of Phone: (COP) (Controllable **?, Discrete, Exogenous, Deterministic)
Range of Values: $0 - 225. Purchase price for the type of phone.

Recurring Costs: (RC) (Uncontrollable, Discrete, Endogenous, Random)
Range of Values: $0 - 40 per month. Periodic service costs, usually monthly.

- RC = MP + BUP + RI +RO + LDC + AM + PM + NPM + AT + FMF + NUMPM + NLDM

Monthly Plan (Minutes/Month): (MP) (Controllable, Discrete, Exogenous, Deterministic) Range of Values: $0 - 40 per month. Companies offer different monthly plans to suit different individual needs based on how many minutes per month the customer needs.

By Usage Plan: (BUP) (Controllable, Discrete, Exogenous, Deterministic)
Range of Values: $0 - .45 per minute. Customer pays for each individual call made rather than with a monthly plan.

Roaming (In Network): (RIN) (Controllable, Discrete, Exogenous, Deterministic)
Range of Values: $0 per minute. Charges associated with making and receiving calls while on the network that the customer has a service plan with (usually free).

Roaming (Outside Network): (RON) (Controllable, Discrete, Exogenous, Deterministic) Range of Values: $0 - .60 per minute. Charges associated with making and receiving calls from another company's network.

Long Distance Charges: (LDC) (Controllable, Discrete, Exogenous, Deterministic)
Range of Values: $0 - .15 per minute. Long distance charges per minute.

Additional Minutes: (AM) (Controllable, Discrete, Exogenous, Deterministic)
Range of Values: $0 - .35 per minute. If the customer exceeds the minutes given in a monthly plan; a fee will be charged for each additional minute.

Peak Minutes: (PM) (Controllable, Discrete, Exogenous, Deterministic)
Range of Values: $0 - .50 per minute. Calls made during peak hours (usually each business day 1200 am – 1159 pm Monday through Friday.

Non-Peak Minutes: (NPM) (Controllable, Discrete, Exogenous, Deterministic)

Decision Environment/Problem Statement

In today's world the need to maintain timely accurate lines of communication is becoming paramount. As a student at the Naval Postgraduate School (NPS), there are a number of reasons for obtaining the use of a cellular phone, both for personal and professional use. The logic behind the selection of a specific plan varies according to the needs of each student. Some wish to maintain communication during the day with family. Many need to coordinate schedule conflicts that arise frequently in dual working families. Others rely on cellular phones for security purposes or ease of communications while traveling on thesis studies.

The choices available to consumers now are also quite limitless. The wide range of services, options, telephone equipment and package plans available are extensive and frequently confusing to the new subscriber. The average student desires to select the best possible plan to meet his needs but does not always have time to determine all alternatives when seeking an appropriate cellular telephone plan.

To solve this problem, a decision support system (DSS) is needed to assist the NPS student in choosing an optimum cellular telephone plan. The DSS system must have the capability of identifying companies whose cellular phone packages meet the objectives of the user.

** Good statement.

Problem Components

In order to structure this cellular telephone DSS, it is critical to correctly identify the components that must be inputted by the user. Individuals may hold different utility preferences that will substantially affect the selection of an optimal solution.

The overall decision objectives for this system are twofold in nature: (1) maximize the user's utility while simultaneously (2) minimizing cost. In other words, the overall decision objective is to obtain the best quality cellular service which meets the user's call requirements at the lowest total cost. Since each of the cellular telephone companies provide rather complicated packages, comparison shopping is complex and difficult.

Decision variables:

- COMPANY (C) Controllable, discrete, endogenous. The model is limited to considering the three major cellular phone providers in the Monterey area: Pacific Bell, Cellular One, and GTE.

- SERVICE PACKAGE (S) Controllable, discrete, endogenous. The specific service packages offered by each company. A service package is specific to a particular company and consists of a combination of fixed and variable costs.

- TELEPHONE (T) Controllable, discrete, endogenous. The type of telephone (analog or digital) and its capabilities (features and options).
** I would suggest here not the TYPE of telephone but rather the actual phone product (i.e., brand/model) … the TYPE would be an attribute of the product and would influence its Utility

- EXPECTED COSTS (C) Random, controllable, continuous, endogenous. Consists of the total cost of owning and operating a cellular phone. Includes both initial and recurring costs. ** why is this a DECISION variable (it should be a criterion)

Influencing Variables:

- CALL TYPE (CT) Controllable, random, discrete, exogenous. Measured as the total number of local, long distance, local/roaming and long distance/roaming calls. Estimated value is entered by the user. Range of values are 0 to 50 per type of call per month.

- COVERAGE (CG) Controllable, discrete, exogenous. Measured as the number of null areas existing within the user's identified areas of required coverage. Estimated value is entered by the user. Each company has an average coverage area. The range of values are 0 to 20 null areas.

- DAILY AVAILABILITY (DA) Controllable, continuous, exogenous. Measured as the total number of hours per day the phone will be available to receive incoming calls (Standby Hours). Estimated value is entered by the user. Range of values are 1 to 24 hours.

- MONTHLY CALL VOLUME (MV) Controllable, random, continuous, exogenous. Measured as the total amount of airtime in minutes per month. Estimated value is entered by the user. Range of values are 20 to 1,500 minutes.

- TELEPHONE OPTIONS (TO) Controllable, discrete, exogenous. Defined by the user answering three yes/no choices that require preferences be made concerning the following options: 1) Call forwarding/waiting, 2) Voice Mail, and 3) Pager services. These options are considered equivalent among service providers but at various costs. Option preference is entered by the user.
** Good, clear

- TELEPHONE PREFERENCE (TP) Controllable, discrete, exogenous. Expressed as either digital or analog. Choice (D or A) is entered by the user.

- TELEPHONE SIZE (TS) Controllable, discrete, exogenous. Enables the user to express a preference for small, medium or large phones per existing

standards within the cellular phone industry. Assumes cellular phones considered by this model are power limited to 3 watts. The definition of small, medium, and large phone size criterion will change as technology improves over time. Choice preference is entered by the user.

- TIME OF CALL (TC) Controllable, random, discrete, exogenous. Measured as whether call is made during peak or non peak periods. Periods are established by the different companies. Estimated value is entered by the user. Range of values are 0 to 50 peak and 0 to 50 non peak calls per month. ** What is the connection between this and MV? They seem to be the same thing?

Outcome Variables

The outcome variables are continuous and endogenous. They are crucial to assisting the user in making his decision concerning the optimum cellular service. Outcome variables include:

- FIXED MONTHLY COST (FMC) The monthly fixed cost of owning and operating a cellular phone with a chosen service package and additional options. Range of values are 0 to 200 dollars.

- INITIAL COST (IC) The initial cost of obtaining cellular service to include the cost of purchasing a telephone and the service activation fees associated with the appropriate package and options. The range of values are 0 to 500 dollars.

- RECURRING COST (RC) The total monthly cost of owning and operating a cellular phone. RC includes FMC and UBC. Range of values are 0 to 500 dollars.

- USAGE BASED COST (UBC) The monthly variable cost of owning and operating a cellular phone with chosen options. UBC is based upon monthly call volume (MCV), time of calls (TC) and type of calls (CT). Range of values are 0 to 300 dollars.

- TOTAL UTILITY (TV) Consists of the sum of the expected cost, company, service package, and telephone utilities. ** No other outcome variables besides the ones involving $ (costs)? What about quality etc?

Alternative Space

In order to structure this cellular telephone DSS, it is critical to correctly identify the components that must be inputted by the user. Individuals may hold different utility preferences that will substantially affect the selection of an optimal solution.

This team identified four areas where alternative spaces are interrelated. The decision questions that need to be addressed include:

1. Which company to use?

2. Which service package to choose?

3. What specific telephone product to choose?

4. What is the total expected cost?

There also are several limitations that arose during the preparation of this dissertation. First, the cellular phones considered in the program do not include the higher powered cellular phones that are typically hardwired into motor vehicles. Secondly, this model only addresses the current programs offered by the three major companies in the area: GTE, Cellular One and Pacific Bell. This model is limited to only three options. All three companies carry these options but at varying costs.
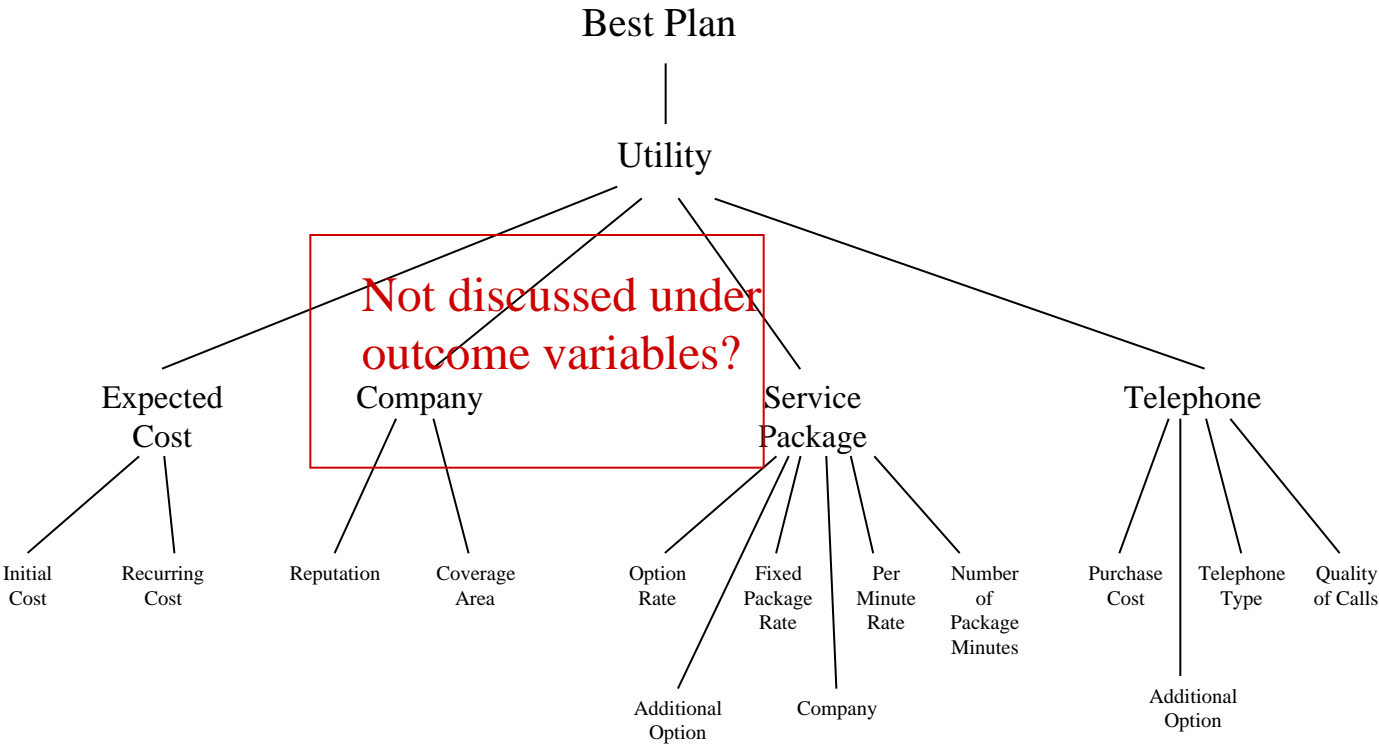** ok

Decision Strategy

The aim of our DSS model is to optimize, selecting the course of action with the highest payoff. The optimal solution in this model is defined as the solution with the lowest cost and the highest utility.

The following enclosures are provided as part of the problem identification and structuring report:
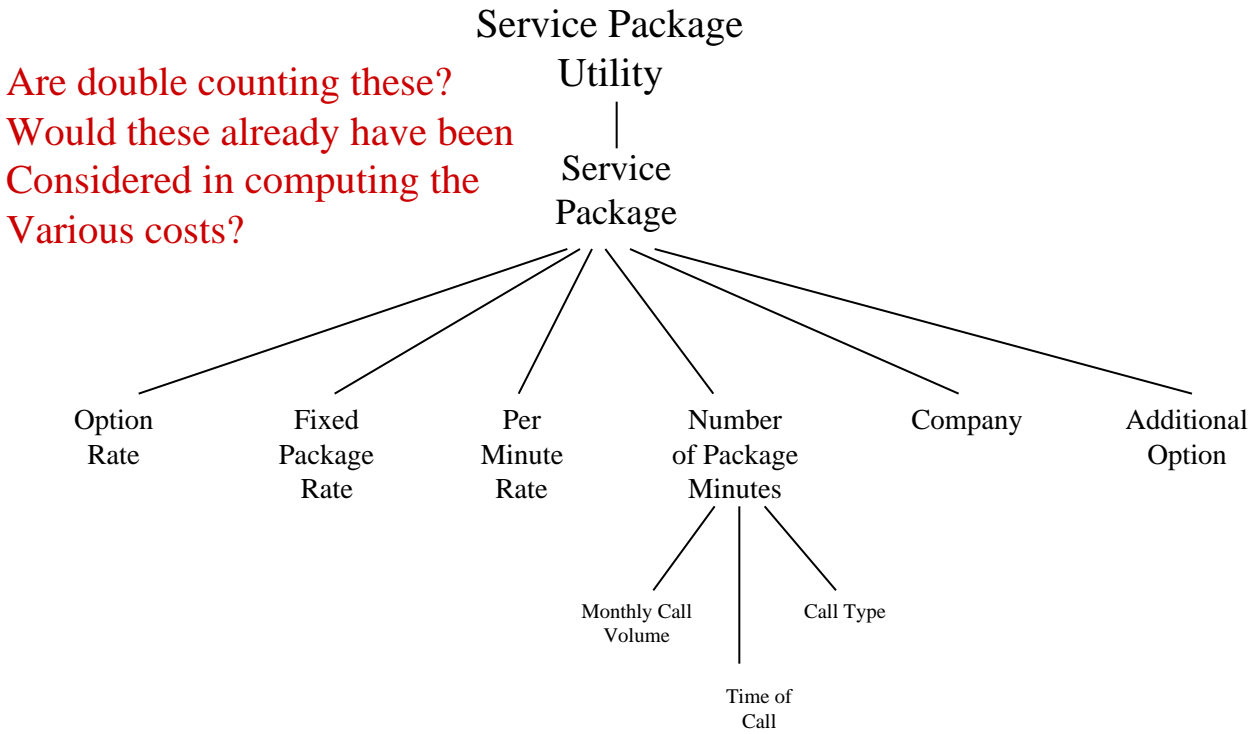
- Enclosure 1: Criteria Hierarchy (Best Plan)

- Enclosure 2: Criteria Hierarchy (Expected Cost Utility)

- Enclosure 3: Criteria Hierarchy (Company Utility)

- Enclosure 4: Criteria Hierarchy (Service Package Utility)

- Enclosure 5: Criteria Hierarchy (Telephone Utility)

- Enclosure 6: Variable Dependencies (Service Package, Cost, and Company)

- Enclosure 7: Variable Dependencies (Telephone, Cost, and Company)

** overall very well done …need to think again about decisions vs outcomes/criteria...minor improvements are needed and doable
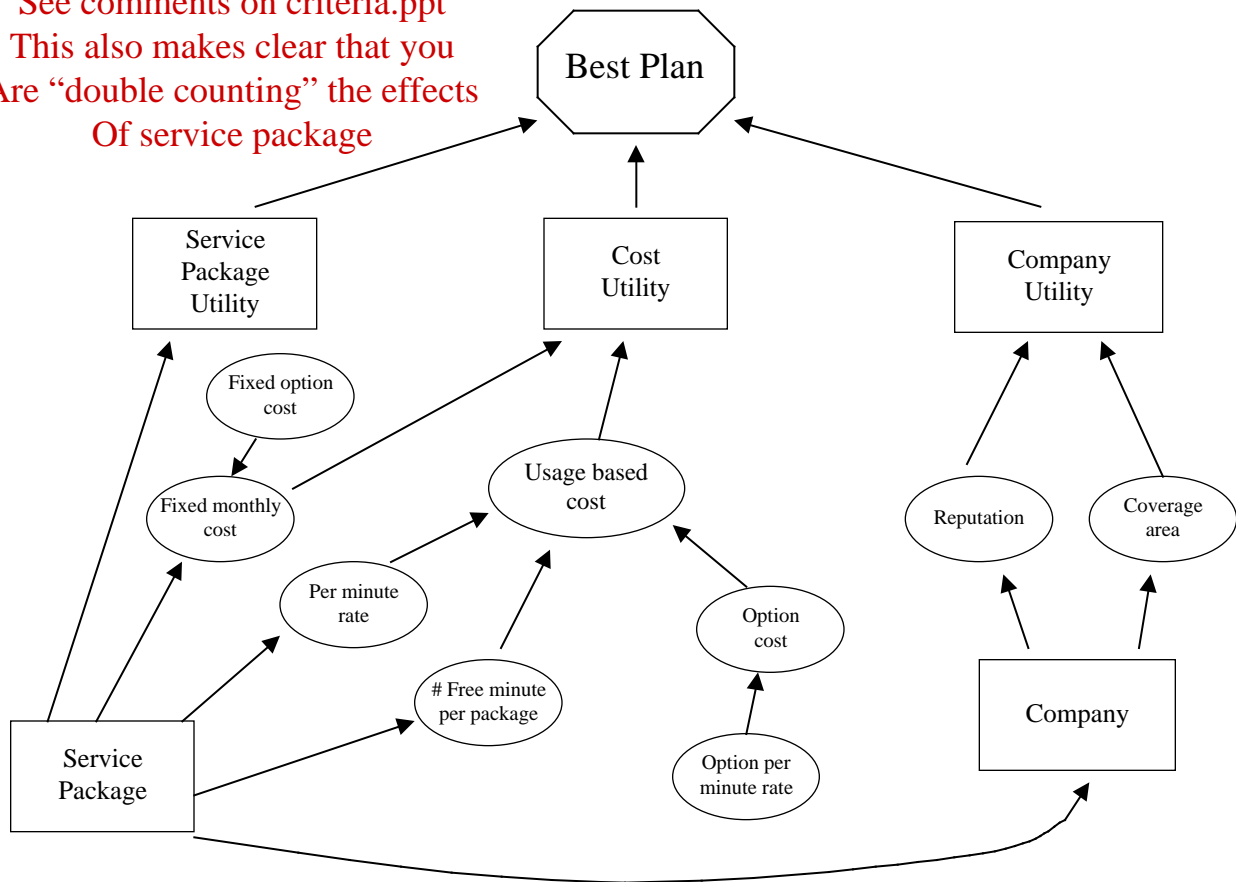
CRITERIA HIERARCHY

Best Plan

Utility

Not discussed under
outcome variables?

Expected
Cost

Company

Service
Package

Telephone

Initial
Cost

Recurring
Cost

Reputation

Coverage
Area

Option
Rate

Fixed
Package
Rate

Per
Minute
Rate

Number
of
Package
Minutes

Purchase
Cost

Telephone
Type

Quality
of Calls

Additional
Option

Company

Additional
Option

CRITERIA HIERARCHY

Service Package
Utility

Are double counting these?
Would these already have been
Considered in computing the
Various costs?

Service
Package

| Option Rate | Fixed Package Rate | Per Minute Rate | Number of Package Minutes | Company | Additional Option |

Monthly Call Volume

Time of Call

Call Type

VARIABLE DEPENDENCIES

Cellular Phone Selection Decision Support System
Problem Identification

Background

Choosing a cellular phone system today is a daunting task, one wrought with options, fees, and changing price schemes. This proposal examines the feasibility and applicability of converting that decision process into an automated one. The intent is to create a decision support system that will accept basic consumer selection criteria, quickly evaluate the available options, and recommend a specific combination.

Problem Objective

The specific objective of this DSS is to improve the user's decision-making capabilities in selecting the best overall service plan. As the sole primary stakeholder the consumer's requirements are the only ones considered. This system will be designed for a one-time use. Although a given user may run several sets of constraints it is envisioned that interaction will be short term as well as nonrecurring. Thus the system will have a simple, inflexible interface with only one outcome advocated.

 ** good statement and nice promise!

Scope

The problems surrounding cellular phone and carrier selection are multifaceted with several Outcome Variables and involve both qualitative and quantitative arguments.

Outcome Variables
Total Cost
The following areas define the decision variables (** why is this under outcome variables?), criteria used for evaluation, and describe their characteristics:
1. Type of technology (Analog, Digital): exogenous, discrete, & deterministic.
(** what are these? Decision variables? Criteria? Or outcomes?)

<u>Digital</u>
Coverage area limited but phones will switch to analog in non-coverage areas
Lower interference

Digital telephones are much harder to clone

Analog
Large, established coverage areas
Eavesdropping
Cloning

2. Type of phone(Mobile, Transportable, Portable): exogenous, discrete, & deterministic.
   Mobile Phone (installed in vehicle)
   Office in your car, Permanently Installed
   Speaker phone, High power, Good out in the country
   No Flexibility, No battery charge

   Transportable Phones
   High power, Good for more than one car
   Requires battery charging, Flexibility

   Portable Phones
   Hand held, Low power
   Requires battery charging
   Flexibility

** Good. So you are discussing pros and cons of the options.But I still don't see whether all of thesea re decision variables or something else. (They should not all be decision variables.)

3. Accessories/Features (cover, additional battery, battery type, memory dialing, size, radio mute, auto answer, call waiting, call forwarding, voice mail, paging, etc.) : exogenous & deterministic.
   From slim line batteries to leather cases.

4. Calling Plan (minutes per month): exogenous, discrete/continuous, & deterministic
   National roaming and long-distance charges, very significant for out of state travelers
   Peak minutes, Off-peak minutes, Planned minutes

5.   Subscriber (** or service PROVIDER ?) (GTE, Cellular One, PacBell): discrete, deterministic, endogenous.

6. Coverage Area(Regional, National) discrete, deterministic, endogenous.

Quality of Service – Outcome variable
The following areas define the decision variables and describe their characteristics:
** I don't see how these are DECISION variables. In fact, the heading above calls them OUTCOME variables. Which one is it? Or are you saying decision and outcome variables are the same thing? Need to clarify this.
   1. Billing practices
           Companies round call length up or down to the next minute
   2. Technical Support
   3. Consumer Reports rating
   4. Call clarity

Other
Compatible equipment – In case the user wants to change carriers in the future. Many of the digital systems operate with proprietary equipment specifications.
Penalties
Penalty for dropped calls
Penalty for service cancellation by customer

Constraints:
Only one service plan can be purchased.

Cost Criteria

Sets:
Phone (type) Company Product : P
Accessories (Battery, Cover, Charger) Company Product: A
Plan (Plan) Company Product: MP
Activation(fee) Company Product: AF ** ??
Additional Minutes (Plan) Company Product: AM

Decisions:
Which phone to select?
Which accessories to select?
Which plan to select?
** Ok. That's correct … but what should I make of the discussion on earlier pages?

Variables:
Startup Cost (P, A, AF, Company/Product)
Recurring Cost(MP, AM, Company/Product)

Quality Of Service Criteria

Sets:
Equipment Reliability, Company/Product
Customer Service, Company/Product
Technical Support, Company/Product
Call Clarity, Company/Product

Decisions:
Which Company/Product has the best equipment reliability?
Which Company/Product has the best technical support?
Which Company/Product has the best customer service?
** Confusing, again! These are questions you'd like to answer, but are they decisions you have to make?

Variables:
Equipment Reliability(Company/Product): ER
Customer Support(Company/Product):CS
Technical Support (Company/Product):TS
Call Clarity(Company/Product):CC

Quality of Service = QoS(ER,CS, TS, CC, Company/Product)

Coverage Area Criteria:

Sets:
Coverage (Regional, National, Company/Product)

Decision:
Which coverage area to select?
** ok

Variables:
Regional (Company/Product)
National (Company/Product)

Coverage Area = CA(Area , Company/Product)

REFERENCES: